



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northwest Fisheries Science Center
Fish Ecology Division
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

March 29, 2004

MEMORANDUM FOR: F/PR - Laurie Allen

FROM: F/NWC3 - John W. Ferguson *John W. Ferguson*

SUBJECT: Estimation of Percentages for Listed Pacific
Salmon and Steelhead Smolts Arriving at Various
Locations in the Columbia River Basin in 2004

Each year your office requests a description of how the Fish Ecology Division calculates the percentages of listed wild and hatchery fish at selected Columbia and Snake River projects. These estimates are necessary for evaluating the potential impacts of proposed research on listed species. Given new hatchery release estimates, we have computed percentages for 2004. The attached tables show our best estimates for the total numbers of protected juvenile Pacific salmon and steelhead arriving at Columbia River and Snake River dams during the 2004 outmigration, and the percentage of the total collection they will comprise at each dam. We have developed estimates based on a "spread the risk" scenario (transportation with spill; assuming river conditions that have existed in the past) and on a full transportation scenario (with no spill). Tables 1-6 show the development of the estimates, and Tables 7-10 summarize the estimates for each listed species at each project. Because permitted take numbers in Appendix H of the 2000 FCRPS Biological Opinion for operation of the Federal Columbia River Hydropower System are presented as percentages of the run, Table 11 presents our estimates of the total run size for each listed group of fish. We are providing this information so that Protected Resources Division (F/PR3) staff can better understand how these percentages were derived.

Several Snake River species will have unmarked hatchery fish released for the 2004 outmigration. Approximately 780,432 hatchery spring/summer chinook salmon will be released with only a coded-wire tag (CWT) (no external mark), of which 450,122 will be from listed stocks. Because we have encountered unmarked hatchery spring/summer chinook salmon in the past, we have adopted a practice of labeling any unclipped spring/summer chinook salmon that is greater than 124-mm in fork length as



hatchery-origin fish. To derive this fork length, we analyzed data from wild spring/summer chinook salmon PIT-tagged in their natal streams (by our wild parr marking project; Permit #1406, Study 1) that were subsequently captured and re-measured at one of the lower Snake River dams during slide-gate evaluations (1989-1994 and 1999-2003).

Approximately 754,000 hatchery steelhead will also be released in 2004 with no external mark and no CWT. Juvenile hatchery steelhead are usually identifiable by their degraded fins, particularly the dorsal and pectoral fins.

Approximately 1,710,000 unlisted Lyons Ferry Hatchery subyearling fall chinook salmon may be released above Lower Granite Dam. Of these fish, 1,530,000 will be unmarked, making them indistinguishable from wild subyearling fish. The effects of these fish are covered in the section on subyearling fall chinook salmon.

All researchers should be aware that 450,000 yearling fall chinook salmon will be released above Lower Granite Dam in 2004, and that 450,000 yearling fall chinook salmon will be released directly from Lyons Ferry Hatchery. All of the Lyons Ferry Hatchery yearling releases will be marked with visual eye tags. Since these hatchery fish are not currently listed, all researchers should be certain that they identify these fish as fall chinook salmon, not as listed yearling spring/summer chinook salmon.

For several groups of fish, we could find no new information; therefore, our estimates for these groups are the same as last year.

Please discuss this memorandum with all interested parties.

Attachments

cc: F/NWC1 - Ford
F/NWC2 - Dickhoff
F/NWC3 - Casillas
F/NWC3 - Dey
F/NWC3 - Ferguson
F/NWC3 - Gores
F/NWC3 - Ruehle
F/NWC3 - Williams
F/NWC4 - Clarke
F/NWC5 - Stein
F/NWR3 - Griffin
F/NWR3 - Schaeffer✓
F/NWR5 - Ruff

SPRING/SUMMER CHINOOK SALMON ESTIMATES

Snake River ESU

Our estimate of wild fish arriving at Lower Granite Dam is based on Idaho Department of Fish and Game and Oregon Department of Fish and Wildlife redd counts for brood year 2002. Redd counts were grouped by drainages for which we had fecundity rates (Middle Fork of the Salmon River, South Fork of the Salmon River, Salmon River (excluding Middle and South Forks), Clearwater River, Imnaha River, and Grande Ronde River). We set the egg-to-smolt survival rate (to Lower Granite Dam) at 10%. We estimate that 2,666,935 wild/natural spring/summer chinook salmon will reach Lower Granite Dam in 2004. We estimate that 11,726,822 hatchery smolts will be released from Idaho (10,691,822) and Oregon (1,035,000).

In order to estimate how many hatchery smolts will reach Lower Granite Dam, we first estimated the percentage composition of Snake River spring/summer chinook salmon arriving at the dam from listed hatcheries (Table 1). Using the mean survival estimates for the 1993-2003 outmigrations (excluding 2001, which was a record low flow year), we estimated the total number of hatchery fish that will arrive at Lower Granite Dam. We applied the mean survival estimate for each hatchery from these 10 years to the 2004 projected release numbers for each hatchery. We estimate that 7,183,388 or 61.25605% of the 11,726,822 hatchery fish released will arrive at Lower Granite Dam.

The percentage composition of listed hatchery spring/summer chinook salmon arriving at Lower Granite Dam in 2004 will be 16.05611% (Table 1). Using this percentage, we estimated the number of listed hatchery fish arriving at Lower Granite Dam.

$$\left(\begin{array}{c} \text{listed hatchery} \\ \text{fish to Granite} \end{array} \right) = \left(\begin{array}{c} \text{total hatchery fish} \\ \text{arriving at Granite} \end{array} \right) \times \left(\begin{array}{c} \% \text{ of listed} \\ \text{hatchery fish} \\ \text{that are listed} \end{array} \right) =$$

$$1,153,373 = 7,183,388 \times 0.1605611$$

Knowing the total number of hatchery fish, the number of listed hatchery fish, and the number of wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed hatchery fish and wild fish arriving at the dam.

$$\begin{aligned} \text{total smolts} &= \text{total hatchery fish} + \text{wild fish} = \\ 9,850,323 &= 7,183,388 + 2,666,935 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish to dam} &= \text{wild fish} / \text{total smolts} = \\ &27.0746\% = 2,666,935 / 9,850,323 \end{aligned}$$

$$\begin{aligned} \% \text{ listed hatchery fish} &= \text{listed hatchery fish} / \text{total smolts} = \\ &11.70898\% = 1,153,373 / 9,850,323 \end{aligned}$$

We set fish guidance efficiencies (FGE) at Lower Granite and Little Goose Dams to 0.393 and 0.418, respectively. Using an FGE of 0.393, the total collection at Lower Granite Dam will be 3,871,177 ($9,850,323 \times 0.393$), based on 9,850,323 smolts arriving at the dam. Wild, listed hatchery, and non-listed hatchery fish, will comprise 1,048,106, 453,275, and 2,369,796 of the total collection, respectively.

Tucannon River fish, both hatchery and wild, are within the Snake River spring/summer chinook salmon Evolutionarily Significant Unit (ESU) and are considered listed fish. In spring 2004, 30,000 wild fish and 169,000 hatchery fish are expected to outmigrate from the Tucannon River. The Tucannon River joins the Snake River between Little Goose and Lower Monumental Dams. Because of the short distance from the confluence to Lower Monumental Dam, we assumed no mortality of these fish prior to Lower Monumental Dam. The estimates shown in Table 2 and Tables 7-8 reflect the addition of these fish above Lower Monumental Dam.

Since 1995, some of the PIT-tagged fish bypassed at the collection dams (Lower Granite, Little Goose, Lower Monumental, and McNary Dams) have been returned to the river to continue migrating inriver. This return of fish to the river requires adjustment of our estimates of the number of listed fish that reach McNary Dam. We estimated the number of fish that will be PIT-tagged for 2004 and, as described in Appendix A, adjusted for fish diverted to transportation at each Snake River collector dam. If transportation occurs at McNary Dam, we also assumed that 100% of all PIT-tagged fish would be returned to the river. A detailed description of how we estimated the impact of returning PIT-tagged fish to the river is presented in Appendix A. We estimated that 22,947 PIT-tagged spring/summer chinook salmon from the Snake River (including 11,591 wild and 4,776 listed hatchery fish) will be collected at McNary Dam because they were returned to the river at an upstream dam(s). These numbers represent collected fish. Dividing the collected number by the FGE at McNary Dam, we determined that 30,583 wild ($11,591 / 0.379$) and 12,602 listed hatchery ($4,776 / 0.379$) fish will arrive at McNary Dam and must be added to the number of fish that were estimated to reach McNary Dam as a result of not having been collected at an upstream dam (column "Listed fish to McNary", Table 2).

Upper Columbia River ESU

The Upper Columbia River ESU spring chinook salmon is listed as endangered under the ESA. The ESU begins at the confluence of the Yakima and Columbia Rivers and continues upstream to Chief Joseph Dam.

Adults that returned in 2002 produced the smolts that will outmigrate in 2004. We obtained 2002 redd counts for the major Columbia River tributaries in this ESU from Washington Department of Fish and Wildlife (WDFW) and the Yakama Indian Nation. Fecundity estimates for this ESU range from 4,000 to 5,500 eggs per female. Estimates for egg-to-smolt survival generally range up to 19%. Using the median egg count, 4,750, and a conservative egg-to-smolt survival estimate (to the first dam encountered) of 15%, we estimated the number of smolts that each stream will produce. We did not receive any 2002 redd count data for the Entiat River, so we estimated the number of redds by multiplying the 2001 redd count by the average change between the 2001 and 2002 redd counts from the Wenatchee and Methow River systems.

We also have hatchery release estimates for this ESU from WDFW and the U.S. Fish and Wildlife Service. There are no survival estimates for these hatcheries. So, based on the distance from the hatchery to the first dam the fish will encounter, we assigned the same survival estimates for Snake River hatcheries, with similar distances to the first dam. Using this method, we assigned a survival rate of 0.773 (Dworshak Hatchery's survival estimate to Lower Granite Dam) to the fish from Winthrop, Methow, Entiat, and Leavenworth Hatcheries, a survival estimate of 0.640 (Rapid River Hatchery's estimate to Lower Granite Dam) to Cle Elum Hatchery, and a survival estimate of 100% to Eastbank and Ringold Hatcheries.

Because we have no per-project survival information for spring chinook salmon in the Columbia River above McNary Dam, we assigned the same per-project estimate (0.9) used on the Snake and lower Columbia Rivers. Survival estimates derived from a 1 year study using yearling hatchery fall chinook salmon support using this estimate (M. Brad Eppard, NMFS, Pers. commun., January 1999).

Based on the assumptions stated above, we derived the estimates shown in Table 7. Based on projected hatchery releases and the number of wild smolts we estimate will outmigrate from the various drainages along the Columbia River above McNary Dam, we estimate that 5,533,745 spring chinook salmon will arrive at McNary Dam. Listed wild, non-listed wild, listed hatchery, and non-listed hatchery fish, will comprise 691,402, 2,685,413, 584,645, and 1,572,285 of the total number, respectively. Note that the numbers shown for Columbia River dams above McNary Dam

are numbers arriving at the dam and not the numbers collected at the dam. The reason for this is that fish guidance efficiency (FGE) for these dams is either unknown or is currently being evaluated.

Estimate of Fish Arriving at McNary Dam

McNary Dam is the first dam on the Columbia River below the confluence of the Snake River. To obtain an estimate of the number of spring/summer smolts arriving at McNary Dam, we added the estimated numbers from the Columbia River above McNary Dam (5,533,745) and the Snake River (1,620,026).

We estimate that 7,153,771 (5,533,745 + 1,620,026) spring/summer chinook salmon smolts will arrive at McNary Dam in 2004, and that 2,711,279 fish will be collected (FGE = 0.379). Of the 2,711,279 smolts collected at McNary Dam, 428,978 (15.8%) will be wild (262,041 Upper Columbia River ESU and 166,937 Snake River ESU), 1,017,772 (37.5%) will be non-listed wild (all non-listed wild fish are from the Columbia River below the Upper Columbia River ESU), 324,098 (12%) will be listed hatchery (221,580 Upper Columbia River ESU and 102,518 Snake River ESU), and 940,431 (34.7%) will be non-listed hatchery fish (595,896 Columbia River and 344,535 Snake River). The ratio of Upper Columbia River ESU wild fish to Snake River ESU wild fish at McNary, John Day, and The Dalles Dams will be 61.1%:38.9% (347,783:221,558). The ratio of Upper Columbia River ESU listed hatchery fish to Snake River ESU listed hatchery fish at McNary, John Day, The Dalles, and Bonneville Dams will be 68.4%:31.6% (264,675:122,456).

We received some redd information from Oregon Department of Fish and Wildlife (ODFW) for the John Day River and, using the same redd to smolt calculation as described above, we added 1,053,075 wild unlisted fish between McNary and John Day Dams. We did not receive any 2002 redd count data for the Deschutes River, so we estimated the number of redds by multiplying the 2001 redd count by the change between the 2001 and 2002 redd counts from the John Day River. This resulted in 633,413 wild unlisted fish being added between John Day and The Dalles Dams. However, because none of these fish are listed, there will be no effect on the ratios of Upper Columbia River ESU and Snake River ESU listed fish.

Lower Columbia River ESU

The Lower Columbia River ESU extends from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. This ESU includes wild spring-run and fall-run chinook salmon. No hatchery fish in this

ESU are listed. The fall-run fish will be discussed below under the subyearling fall chinook salmon section. We have no information on spawning above Bonneville Dam for this ESU. This ESU will introduce 1,152,358 spring chinook salmon below Bonneville Dam.

Estimate of Fish Arriving at Bonneville Dam

At Bonneville Dam, the ratio of Upper Columbia River ESU, Snake River ESU listed wild fish (there is no information on Lower Columbia River ESU spawning above Bonneville Dam) will be 61.1%:38.9% (313,005:199,402).

Fish transported from Snake River dams and McNary Dam are released below Bonneville Dam. The number of listed transport fish returned to the river will be 3,104,966 (2,106,656 wild and 998,310 listed hatchery) and 473,276 (254,961 wild and 218,315 listed hatchery) for the Snake River and Upper Columbia River ESUs, respectively. A total of 9,901,268 transported spring/summer chinook salmon will be released below Bonneville Dam.

Upper Willamette River ESU

The Upper Willamette River ESU contains spring chinook salmon populations above Willamette Falls. No hatchery fish in this ESU are listed. This ESU will introduce 4,464,443 listed wild spring chinook salmon to the Columbia River below Bonneville Dam.

The ratio of Upper Columbia River ESU, Snake River ESU, Lower Columbia River ESU, and Upper Willamette River ESU listed wild fish at Tongue Point will be 7.2%:29.3%:14.6%:48.9% (567,966:2,306,058:1,152,358:3,847,700). The ratio of Upper Columbia River ESU listed hatchery fish and Snake River ESU listed hatchery fish at Tongue Point will be 30.1%:69.9% (482,990:1,120,766).

Per-project survival (0.9) was retained from last year's (2003) estimate (Table 2).

Summary

Tables 7 and 8 present a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2004. This information is derived from the data shown in Tables 1-2 and Appendix Table A1. Table 11 shows the estimated number of spring

and spring/summer chinook salmon expected to outmigrate from each ESU.

SUBYEARLING FALL CHINOOK SALMON ESTIMATES

To estimate the 2004 collection number at Lower Granite Dam, we used the 2003 collection number and the adult returns over the dam for 2002 and 2003. In 2003, 1,040,000 unmarked hatchery subyearling fall chinook salmon were released above Lower Granite Dam. Assuming a survival rate of 0.801 (the estimated survival rate of hatchery subyearling fall chinook salmon released above Lower Granite Dam in 2003), 833,040 ($1,040,000 \times 0.801$) of these fish would have arrived at Lower Granite Dam. Assuming an FGE of 0.472 (derived from PIT-tagged hatchery subyearling fall chinook salmon in 2003), 393,195 ($833,040 \times 0.472$) would have been collected at Lower Granite Dam. Through 31 December 2003, 678,866 unclipped (and without a coded-wire tag) subyearling chinook salmon had been collected at Lower Granite Dam. By removing the estimated 393,195 unmarked hatchery subyearling fall chinook salmon, we estimate that 285,671 ($678,866 - 393,195$) wild subyearling fall chinook salmon were collected at Lower Granite Dam in 2003. These wild subyearling fall chinook salmon were from the 2002 adult return. The adult count over Lower Granite Dam in 2002 was 12,312. Of these, 2,830 were hatchery fish that were returned to Lyons Ferry Hatchery and 9,482 adults were passed above Lower Granite Dam. The 2004 outmigration will be the result of the 2003 adults passed over Lower Granite Dam. Through 31 December 2003, 11,732 adults had been counted in the adult ladder. Of these, 776 fish were returned to Lyons Ferry Hatchery, leaving 10,956 adults that were passed above Lower Granite Dam. The 2003 count of 10,956 adults represents a 1.155 increase over the 2002 count (9,482). We applied this increase (1.155) to the 2003 subyearling collection number to arrive at the estimated 2004 collection number.

$$\left(\begin{array}{c} \text{total wild fall chinook} \\ \text{collected at Granite} \end{array} \right) = \left(\begin{array}{c} \text{wild fall chinook} \\ \text{collected in 2003} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts} \\ \text{for 2003 and 2004 outmigrations} \end{array} \right) =$$

$$329,950 = 285,671 \times 1.155$$

We estimated the total number of wild subyearling fall chinook salmon arriving at Lower Granite Dam by dividing the number of wild fish collected by the FGE at Lower Granite Dam. The average estimated FGE for PIT-tagged hatchery subyearling fall chinook salmon arriving at Lower Granite Dam from 1995-2003 (excluding 2001) is 0.525.

$$\begin{aligned} \text{total wild fall chinook} &= \text{total wild fall chinook collected} / \text{FGE} = \\ 628,476 &= 329,950 / 0.525 \end{aligned}$$

The Nez Perce Tribe will release 1,710,000 unlisted supplementation subyearling fall chinook salmon in the Clearwater River basin in 2004. Of these fish, 1,530,000 will be unmarked. Assuming a survival rate of 0.347 (the average estimated survival rate of PIT-tagged hatchery subyearling fall chinook salmon released above Lower Granite Dam from 1995-2003 (excluding 2001)), 530,910 ($1,530,000 \times 0.347$) of these fish will arrive at Lower Granite Dam. By adding these fish to the total number of wild fall chinook salmon (628,476), we estimate that 1,159,386 unmarked subyearling fall chinook salmon will arrive at Lower Granite Dam. The percentage of unmarked subyearling fall chinook salmon that are wild will be 54.21% ($628,476/1,159,386$). Of the 180,000 ($1,710,000 - 1,530,000$) marked hatchery subyearling fall chinook salmon to be released above Lower Granite Dam, 62,460 ($180,000 \times 0.347$) will arrive at Lower Granite Dam. We added the total unmarked fish (1,159,386) and the total marked fish (62,460) to determine the total number of subyearling fall chinook arriving at Lower Granite Dam (1,221,846).

Knowing the total number of fish and the number of wild fish, we estimated the number of fish collected at Lower Granite Dam, and the percentage composition of wild fish arriving at Lower Granite Dam.

$$\begin{aligned} \text{fall chinook collected} &= \text{total fall chinook} \times \text{FGE} = \\ 641,469 &= 1,221,846 \times 0.525 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish} &= \text{total wild fall chinook} / \text{total fall chinook} = \\ 51.4\% &= 628,476 / 1,221,846 \end{aligned}$$

NMFS has conducted subyearling fall chinook salmon survival tests since 1995. As part of these tests, we estimated actual FGE's for McNary Dam (factoring in effects of spill). To more accurately estimate the collection number at McNary Dam, we averaged these actual FGE's for 1995-2003 (excluding 2001). We also averaged the number of fall chinook salmon adults crossing McNary Dam for each of the brood years (1994-2002) and the number of juvenile subyearling fall chinook salmon collected at McNary Dam (1995-2003). The 2003 count of 180,618 adults represents 2.151 of the average for 1994-2002 count (83,983). We applied this change (2.151) to the average 1995-2002 subyearling collection number (6,651,573) to arrive at an estimated 2004 collection number (14,307,534).

Based on the NMFS subyearling fall chinook salmon survival studies conducted in 1995-2003 (excluding 2001), per-project survival was set at 75%. We set the FGEs at Little Goose, Lower Monumental, and McNary Dams, based on 1995-2003 (excluding 2001) NMFS fall chinook salmon survival study results, to 0.474, 0.446, and 0.509, respectively.

Lower Columbia River ESU

The Lower Columbia River wild tule and late-run bright fall chinook salmon have been added to the list of protected species. No hatchery fish are listed in this ESU.

To determine the number of wild outmigrants from this ESU, we assumed that 50% of the adults counted in the spawning areas were female and that every female spawned successfully. We used average fecundity and set the egg-to-smolt survival rate at 15%, the same used for spring/summer chinook salmon.

Based on this method of estimation, we estimate that 394,528 tule fall chinook salmon will outmigrate from above Bonneville Dam. No late-run bright fish will enter the Columbia River above Bonneville Dam. Additionally, 8,177,741 tule fall chinook salmon and 4,009,111 late-run bright fall chinook salmon should enter the Columbia River below Bonneville Dam.

The ratio of Snake River ESU and Lower Columbia River ESU (tule fall chinook salmon) listed wild fish at Bonneville Dam will be 1.4%:98.6% (5,745:394,528).

Fish transported from Snake River dams and McNary Dam are released below Bonneville Dam. The number of listed transport fish returned to the river will be 489,587, all from the Snake River ESU. A total of 15,321,114 transported subyearling fall chinook salmon will be released below Bonneville Dam.

The ratio of Snake River ESU, Lower Columbia River ESU (tule fall chinook salmon), and Lower Columbia River ESU (late-run bright fall chinook salmon) listed wild fish at Tongue Point will be 3.8%:65.6%:30.7% (495,332:8,572,269:4,009,111).

Summary

Table 7 presents a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2004. This information is derived from the data shown in Table 2. Table 11 shows the estimated number of fall chinook salmon expected to outmigrate from each ESU.

SOCKEYE SALMON ESTIMATES

The sockeye salmon collection count at Lower Granite Dam was based on IDFG's estimate of wild and hatchery-reared sockeye salmon smolts exiting the upper Salmon River in 2004 and their estimates of survival to Lower Granite Dam. IDFG estimates that 5,999 wild fish and 23,785 hatchery fish that have overwintered in the lakes will survive to Lower Granite Dam in spring 2004. All of these fish are listed as endangered.

listed sockeye (wild and hatchery) to Lower Granite Dam =
IDFG's estimated wild fish + estimated hatchery fish =
 $29,784 = 5,999 + 23,785$

To determine the percentage of wild sockeye salmon collected at Lower Granite Dam, we estimated the number of kokanee arriving at Lower Granite Dam. In 2003, we estimated that 280 wild Redfish Lake sockeye salmon would be collected at Lower Granite Dam. During that outmigration, spill from Dworshak Dam released kokanee that were collected at Lower Granite Dam. The total collection of wild *Oncorhynchus nerka* salmon at Lower Granite Dam for 2003 (through 31 December 2003) was 2,746, 2,466 of which (2,746 - 280) were kokanee. With an FGE of 0.280 (the 2003 estimate), 8,807 (2,466/0.280) kokanee reached Lower Granite Dam. Assuming the same amount of spill from Dworshak Dam in 2004 with a release of the same number of kokanee, we estimated the total number of wild *O. nerka* arriving at Lower Granite Dam to be 14,806 (8,807 + 5,999). We then estimated the percentage of wild *O. nerka* arriving at Lower Granite Dam that will be listed Snake River sockeye salmon.

% listed wild sockeye =
listed wild sockeye/total wild *O. nerka* to Lower Granite Dam =
 $40.5\% = 5,999/14,806$

A total of 38,591 (29,784 listed sockeye + 8,807 kokanee) *O. nerka* will arrive at Lower Granite Dam.

% total listed sockeye =
total listed sockeye/total *O. nerka* to Lower Granite Dam =
 $77.2\% = 29,784/38,591$

An FGE of 0.279 (average for 1998-2003 (excluding 2001)) was used to estimate the number of *O. nerka* smolts reaching Lower Granite Dam that will be collected.

O. nerka salmon collected = total *O. nerka* salmon x FGE =
 $10,767 = 38,591 \times 0.279$

Because of extreme year-to-year variability, the count used at McNary Dam for 2004 is based on the average of the counts at the dam from 1985 to 2003 (580,208). Project survival was set at the yearling chinook salmon level (Table 2).

Summary

Table 7 presents a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2004. This information is derived from the data shown in Table 2. Table 11 shows the estimated number of sockeye salmon expected to outmigrate from the Snake River ESU.

STEELHEAD ESTIMATES

Because of the time of year that steelhead spawn, it is very difficult to obtain redd count information. All of our steelhead estimates, not otherwise explained, are based on adult counts in the spawning areas. We assumed that 65% of the adults were females and that every female spawned successfully. To estimate the number of outmigrants, we used average fecundity estimates, and assigned an egg-to-smolt survival rate of 1%. This survival rate is conservative as all rates we calculated or found in the literature were from 0.5% to 0.75%.

SNAKE RIVER STEELHEAD ESU

Prior to the 2001 outmigration, nearly all hatchery steelhead were fin-clipped, allowing us to use the juvenile collection numbers at Lower Granite Dam without making any adjustments for unclipped hatchery fish. Because it was known that a large number of unclipped steelhead were to be released for the 2003 outmigration, WDFW not only recorded the number of unclipped steelhead collected but also the number of unclipped steelhead that had fin erosion, a strong indicator that a fish is of hatchery origin. Based on the information provided by WDFW (Fred Mensik, WDFW, Pers. commun., August 2003), we determined that 240,814 wild steelhead were collected at Lower Granite Dam in 2003 (0.463, or 207,863, of the 448,677 unclipped steelhead collected at Lower Granite Dam in 2003 had fin erosion). We applied the 2003 estimated FGE (0.336) to the collection number to determine that 716,708 ($240,814/0.336$) wild steelhead arrived at Lower Granite Dam in 2003.

To our knowledge, no research has been conducted on the age-class distribution of migrating juvenile steelhead in the Snake River; however, there has been research on the mid-Columbia River (Pevan et al. 1994¹). Pevan's research showed that in the mid-Columbia River, migrating steelhead were 0.7% age-1, 43.2% age-2, 46.4% age-3, and 8.6% age-4 smolts. The age-class of the remainder of smolts (1.1%) was greater than age-4, up to age-7. Because of this age-class breakdown, we decided to base our estimates on age-classes 1 to 4. Because steelhead spawn in the spring, our annual counts were from 1 July to 30 June, rather than by calendar year. Using the adult counts at Lower Granite Dam of the 4 years that comprised the 2003 wild smolt outmigration

¹ Pevan, C. M., R. R. Whitney, and K. R. Williams. 1994. Age and length of steelhead smolts from the Mid-Columbia River Basin, Washington. N. Am. J. Fish. Manage. 14:77-86.

(1999-2002 brood years, 1 July 1998-30 June 2002), and applying the smolt age-class percentages to the adult counts for each of these 4 years, we estimated that 15,911 of the adults passing Lower Granite Dam produced the 2003 steelhead outmigration. We performed the same calculation to estimate the number of adults from the 4 years (2000-2003 brood years) producing the 2004 wild outmigration. We calculated that the 2004 wild outmigration will be based on 33,072 adults, or 207.9% of the number of fish producing the 2003 outmigration. We applied the change in the number of adults to the number of wild steelhead that arrived at Lower Granite Dam in 2003 (716,708) to determine the estimated 2004 arrival number.

$$\left(\begin{array}{c} \text{total wild steelhead} \\ \text{arriving at Lower Granite} \end{array} \right) = \left(\begin{array}{c} \text{wild steelhead} \\ \text{arriving in 2003} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts} \\ \text{for 2003 and 2004 outmigrations} \end{array} \right) =$$

$$1,490,036 = 716,708 \times 2.079$$

For the steelhead hatchery release numbers, we used IDFG's, ODFW's, and WDFW's estimates of hatchery releases in Idaho, Oregon, and Washington. We estimate that 9,072,500 hatchery smolts (Table 4) will be released from Idaho (7,784,500), Oregon (1,128,000), and Washington (160,000 in the Grande Ronde River). In the Snake River above Lower Granite Dam, no hatchery steelhead are listed under the ESA.

In order to estimate how many hatchery smolts will reach Lower Granite Dam, we attempted to use the survival estimates for the 1993-2003 outmigrations (excluding 2001) (from the NMFS survival study, Research Action #1212). We found that survival estimates have only been made for two hatcheries, Dworshak National Fish Hatchery (0.784) and Clearwater Hatchery (0.638). We applied the survival estimate from Dworshak National Fish Hatchery to the other hatcheries that did not have estimates. Using these estimates with the 2004 projected release numbers for each hatchery, we estimated how many total hatchery fish will arrive at Lower Granite Dam. We estimate that 6,962,606 or 76.744% of the 9,072,500 hatchery fish released will arrive at the dam (Table 4).

Knowing the numbers of hatchery and wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed wild fish arriving at the dam.

$$\begin{aligned} \text{total smolts} &= \text{total hatchery fish} + \text{wild fish} = \\ 8,452,642 &= 6,962,606 + 1,490,036 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish to Lower Granite Dam} &= \text{wild fish} / \text{total smolts} = \\ 17.6\% &= 1,490,036 / 8,452,642 \end{aligned}$$

We set FGEs at Lower Granite and Little Goose Dams at 0.408 and 0.451, respectively. Using an FGE of 0.408, the total collection at Lower Granite Dam will be 3,448,678 ($8,452,642 \times 0.408$), based on 8,452,642 smolts arriving at the dam. Wild and hatchery fish, will comprise 607,935 ($1,490,036 \times 0.408$) and 2,840,743 ($3,448,678 - 607,935$) of the total collection, respectively.

Wild/natural Tucannon River drainage fish are listed within the Snake River ESU. In spring 2004, 25,000 wild fish are expected to outmigrate from the Tucannon River. In addition, 204,000 non-listed hatchery fish will be released into the Tucannon River or released directly from Lyons Ferry Fish Hatchery. The Tucannon River joins the Snake River between Little Goose and Lower Monumental Dams. Because of the short distance from the confluence to Lower Monumental Dam, we assumed no mortality of these fish prior to Lower Monumental Dam. The estimates shown in Table 5 and Tables 9-10 reflect the addition of these fish above Lower Monumental Dam.

WDFW will release 145,000 non-listed hatchery steelhead into the Touchet River, a tributary of the Walla Walla River, and 100,000 non-listed hatchery steelhead (from Mid-Columbia River ESU stock) into the Walla Walla River. The Walla Walla River enters the Columbia River above McNary Dam. For these fish, survival to McNary Dam was set at 100%.

Over the past 4 years, all PIT-tagged fish bypassed at the collection dams (Lower Granite, Little Goose, Lower Monumental, and McNary Dams) have been returned to the river to continue migrating inriver. This return of fish to the river requires adjustment of our estimates of the number of listed fish that reach McNary Dam. We estimated the number of fish that will be PIT tagged for 2004 and, as described in Appendix A, adjusted for fish diverted to transportation at each Snake River collector dam. A detailed description of how we estimated the impact of returning PIT-tagged fish to the river is presented in Appendix B. We estimated that 4,869 PIT-tagged steelhead from the Snake River (including 537 wild fish) will be collected at McNary Dam because they were returned to the river at an upstream dam(s). These numbers represent collected fish. Dividing the collected number by the FGE at McNary Dam, we determined that 2,795 wild Snake River steelhead ($537/0.192$) will arrive at McNary Dam and must be added to the number of fish that were estimated to reach McNary Dam as a result of not having been collected at an upstream dam (column "Listed fish to McNary", Table 5).

Upper-Columbia River ESU Steelhead

Very little is known regarding wild steelhead in the Columbia River above the confluence with the Yakima River. Also, little is known regarding dam passage of smolts at the dams above McNary Dam. Because of this lack of information, the estimates of wild steelhead from the listed Upper Columbia River ESU are based on what little information is available and on broad generalizations based on this information. No FGE's have been established for the dams in this reach, so the numbers presented in this section of the memorandum (and in Tables 9 and 10) are the number of fish arriving at the dam, not collection numbers (unless otherwise noted in the text).

As mentioned above, Pevan et al. (1994) showed that migrating steelhead were 0.7% age-1, 43.2% age-2, 46.4% age-3, and 8.6% age-4 smolts. The age-class of the remainder of smolts (1.1%) was greater than age-4, up to age-7. Because of this age-class breakdown, we decided to base our estimates on age-classes 1 to 4.

We based our estimates of wild fish on counts collected at Rock Island Dam by the Fish Passage Center. During the 2003 outmigration, 6,800 wild steelhead smolts were counted in the Smolt Monitoring Program's sample. It is estimated that the sample represents 3-5% of the fish passing the dam. Using a 4% sample rate, we estimated that 170,000 wild steelhead passed Rock Island Dam in 2003.

We then examined the adult counts at Rock Island Dam. Because steelhead spawn in the spring, our annual counts were from 1 July to 30 June, rather than by calendar year. Using the adult counts of the 4 years that comprised the 2003 wild smolt outmigration (1999-2002 brood years, 1 July 1998-30 June 2002), and applying the smolt age-class percentages to the adult counts for each of these 4 years, we estimated that 8,187 of the adults passing Rock Island Dam produced the 2003 steelhead outmigration. We performed the same calculation to estimate the number of adults from the 4 years (2000-2003 brood years) producing the 2004 wild outmigration. We calculated that the 2004 wild outmigration will be based on 17,850 adults, or 2.180 of the number of fish producing the 2003 outmigration. We applied the change in the number of adults to the 2003 Rock Island Dam collection to arrive at the estimated 2004 collection number.

$$\left(\begin{array}{c} \text{total wild steelhead} \\ \text{collected at Rock Island} \end{array} \right) = \left(\begin{array}{c} \text{wild steelhead} \\ \text{collected in 2003} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts} \\ \text{for 2003 and 2004 outmigrations} \end{array} \right) =$$

$$14,824 = 6,800 \times 2.180$$

Since this represents 4% of the fish passing the dam, we estimate that 370,600 wild steelhead smolts will pass the dam in 2004. Using the smolt age-class percentages, we estimate that 2,594 smolts will be age-1, 160,099 will be age-2, 171,958 will be age-3, and 31,872 will be age-4.

To determine the number of wild smolts passing the two dams above Rock Island Dam (Rocky Reach and Wells Dams), we used the estimate of wild smolts passing Rock Island Dam (370,600) and the adult counts at all three dams.

By comparing the adult counts at each of the three dams for the 4 years that will produce the 2004 outmigration (2000-2003), we calculated the number of adults "lost" between each dam. We assigned this "loss" to adults migrating up rivers between the dams. The difference in adult counts between dams varied between years, so we applied the age-class percentages to each year's differences between dams to determine the number of wild smolts added from the rivers between the dams.

From Rock Island Dam to McNary Dam, the only adjustment made to the wild steelhead smolt count was for per-project survival (0.9%).

To determine the number of hatchery smolts arriving at each dam in 2004, we used the outplanting data for the 3 years comprising the 2004 outmigration (2002-2004). Because hatchery fish are larger than equivalent age-class wild fish, we assigned age-2 status to hatchery fish released in 2004, age-3 to those released in 2003, and age-4 to those released in 2002. All of the hatchery outplants will be of listed hatchery stocks.

Because there are no survival data for the various hatcheries releasing fish in this section of the Columbia River, we assumed that all fish released survived to the first dam. We again applied the age-class percentages to the number of fish released each of the 3 years to determine the number of hatchery fish that would outmigrate in 2004. Beginning at Wells Dam and assuming 90% per-project survival, we determined both the number of listed hatchery and the total number of hatchery fish reaching each dam through McNary Dam (Tables 5 and 9).

Mid-Columbia River ESU Steelhead

The Mid-Columbia River wild summer-run and winter-run steelhead have been added to the list of protected species. There are no listed hatchery stocks in this ESU. Only summer steelhead from the Yakima and Walla Walla Rivers enter the Columbia River above McNary Dam.

Based on our estimates described in the steelhead introduction, 90,370 wild summer steelhead will enter the Columbia River above McNary Dam in 2004. An additional 228,114 wild summer steelhead from this ESU will be added between McNary and John Day Dams, and 65,160 wild summer steelhead will be added between John Day and The Dalles Dams.

Estimate of Fish Arriving at McNary Dam

McNary Dam is the first dam on the Columbia River below the confluence of the Snake River. To obtain an estimate of the number of steelhead smolts arriving at McNary Dam, we added the estimated numbers from the Upper Columbia River (1,179,166), Mid-Columbia (90,370) and the Snake River (1,375,637) ESUs.

We estimate that 2,645,173 (1,179,166 + 90,370 + 1,375,637) steelhead smolts will arrive at McNary Dam in 2004, and that 507,873 fish will be collected. Of the 507,873 smolts collected at McNary Dam, 105,840 (0.208) will be wild (51,872 Upper Columbia River ESU, 36,617 Snake River ESU, and 17,351 Mid-Columbia River ESU), 142,572 (0.281) will be listed hatchery (all from the 142,572 Upper Columbia River ESU), and 259,461 (0.511) will be unlisted hatchery fish (31,956 Columbia River and 227,505 Snake River). The ratio of Upper Columbia River ESU wild fish, Snake River ESU wild fish and Mid-Columbia River ESU wild fish at McNary, John Day, and The Dalles Dams will be

	McNary Dam	John Day	The Dalles
Upper Columbia	49 (51,872)	32.4 (196,466)	29.3 (176,819)
SNAKE RIVER	34.6 (36,617)	22.9 (138,686)	20.7 (124,817)
Mid-Columbia			
summer	16.4 (17,351)	44.7 (271,020)	50.1 (302,562)
winter	—	—	—

All listed hatchery steelhead are from the Upper Columbia River ESU.

Lower Columbia River ESU

We estimate that 47,074 wild steelhead from this ESU will arrive at Bonneville Dam. The effects of this are shown in the

"Bonneville Dam" lines in Tables 9 and 10. The ratio of the various ESUs will be

Bonneville Dam

Upper Columbia	26.2	(159,137)
Snake River	18.5	(112,335)
Mid-Columbia		
summer	44.8	(272,306)
winter	2.7	(16,557)
Lower Columbia	7.8	(47,074)

There are no listed hatchery fish in the Lower Columbia River ESU.

Another 216,758 wild steelhead are expected to enter the Columbia River from Washington and Oregon downstream from Bonneville Dam to the Cowlitz River.

Fish transported from Snake River dams and McNary Dam are released below Bonneville Dam. The number of listed transport fish returned to the river will be 1,187,675 (1,187,675 wild and 0 listed hatchery), 194,181 (51,609 wild and 142,572 listed hatchery), and 17,263 (all wild) for the Snake River, Upper Columbia River, and Mid-Columbia River (summer-run) ESUs, respectively. A total of 7,072,461 transported steelhead will be released below Bonneville Dam.

Upper Willamette River ESU

The Upper Willamette River wild winter-run steelhead have been added to the list of protected species. There are no listed hatchery stocks in this ESU.

Based on our estimates described in the steelhead introduction, 248,516 winter steelhead will enter the Columbia River in 2004, 216,737 of which will be from listed stocks.

At Tongue Point the ratios of the various ESUs will be

Tongue Point

Upper Columbia	9.2	(210,746)
Snake River	56.6	(1,300,010)
Mid-Columbia		
summer	12.6	(289,569)
winter	0.7	(16,557)
Lower Columbia	11.5	(263,832)
Upper Willamette	9.4	(216,737)

All listed hatchery steelhead are from the Upper Columbia River ESU.

Summary

Tables 9 and 10 summarize the estimated number of steelhead that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the collection dams during 2004. This information is derived from the data shown in Tables 4-5 and Appendix Table B1. Table 11 shows the estimated number of steelhead expected to outmigrate from each ESU.

CHUM ESTIMATES

Columbia River ESU

Wild chum salmon in the Columbia River have been added to the list of protected species. No hatchery fish are listed.

We attempted to gather new data for chum, but will not receive any information until later in the spring. The chum adult count at Bonneville Dam in 2003 was 2.5 times that in 2002 (177 vs. 72). Preliminary data indicate that chum numbers at Ives Island were about half those seen in 2002, but peak live counts at other sites on the lower Columbia River were higher in 2003; however, we do not believe we have enough data to make an estimate of listed chum salmon. We expect the hatchery chum salmon outmigration to be 100,000 from Washougal River (released in Duncan Creek), 147,500 from Chinook River, and 395,000 from Grays River.

Full Transportation Scenario

The estimates shown in Table 3 were derived using the same methodology utilized under the Transportation with Spill Scenario, with one major difference. The number of fish removed at each dam under the Transportation with Spill Scenario was based on an FGE value that adjusted for spill. For our estimates under the Full Transportation Scenario, we used the FGE values developed during testing of the diversion screens installed in each of the turbine intakes. Using the results from these tests, the FGEs for spring/summer chinook salmon and sockeye salmon were changed from the values in Table 2 to 60.0%, 65.0%, 50.0%, and 80.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Subyearling fall chinook salmon FGEs were changed from the values in Table 2 to 55.0%, 60.0%, 40.0%, and 65.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Steelhead FGEs (in Table 6) were changed from the values in Table 5 to 80.0%, 90.0%, 65.0%, and 90.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Using the same formulas as under the Transportation with Spill Scenario, we derived the values found in Tables 3 and 6-10.

Because the adjusted FGE at Lower Granite Dam was changed from 39.3% to 60.0% for yearling spring/summer chinook and sockeye salmon, the total number of fish collected at Lower Granite Dam will be 5,910,194 ($9,850,323 \times 0.60$) spring/summer chinook salmon and 23,155 ($38,591 \times 0.60$) *O. nerka* salmon.

Because more PIT-tagged fish will be collected at the upstream dams, the number of PIT-tagged fish that are returned to the river and subsequently collected at McNary Dam will be different under this scenario. The effects of this are shown in Appendices A and B.

As under the Transportation with Spill Scenario, to estimate the number of spring/summer chinook salmon smolts arriving at McNary Dam, we added the estimated numbers from the Columbia River above McNary (5,533,745) and the Snake River (600,797).

$$5,533,745 + 600,797 = 6,134,542$$

Tables 7-10 show the changes in percentages of listed fish at each dam.

Table 1. Estimated percentage composition of Snake River spring/summer chinook salmon arriving at Lower Granite Dam from listed hatcheries compared with total hatchery releases projected for spring 2004.

Hatchery	Total hatchery releases ^a 2004	Survival to Lower Granite Dam Mean ^b	Fish to Lower Granite Dam
Dworshak ^c	1,050,000	0.773	811,650
Kooskia ^c	650,000	0.662	430,300
Lookingglass			
Imnaha ^d	398,000	0.651	259,098
Grande Ronde ^c	637,000	0.641	408,317
Clearwater ^c	2,206,000	0.600	1,323,600
Rapid River ^c	3,563,500	0.640	2,280,640
Sawtooth ^d	821,000	0.384	315,264
McCall ^{c,d}	1,265,342	0.539	682,019
Pahsimeroi ^{c,d}	1,135,980	0.592	672,500
Totals			
All stocks	11,726,822		7,183,388
Listed stocks	2,160,122		1,153,373
Percent of listed stocks	18.420%		16.05611%

^a Data from IDFG and ODFW.

^b Mean survival estimate made from PIT-tag detections of marked hatchery fish releases as part of the NMFS survival studies (Research Action #1212) for 1993-2003 (excluding 2001).

^c Non-listed stocks.

^d Listed stocks in 2004 (only 176,342 of the 1,265,342 McCall Hatchery fish and 127,780 of the 1,135,980 Pahsimeroi Hatchery fish are listed).

Table 2. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2004 under past transportation and spill conditions.

Yearling spring/summer chinook salmon

Snake River ESU													
Rearing type	Total Collection*		Of Granite Total		Listed Fish		FGE ¹		McNary	Project Survival	Listed fish		Of Fish Collected
	Granite	McNary	% Listed Fish	to Granite*	Granite	Goose	Low Mon**	to McNary ^b			Listed Fish & Listed Fish		
Wild	3,871,177	2,711,279	27.1	2,666,935	0.393	0.418	0.362	0.379	0.9	440,466	166,937	6.16	
Listed hatchery***	3,871,177	2,711,279	11.7	1,153,373	0.393	0.418	0.362	0.379	0.9	270,496	102,518	3.78	
Upper Columbia River ESU													
Rearing type	Number of listed fish passing dam			Of dam total, & listed fish			FGE	Project Survival	Listed fish		Of Fish Collected		
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island			to McNary ^b	Listed Fish & Listed Fish			
Wild****	849,301	795,721	948,424	50.4	43.0	29.9	0.379	0.9	691,402	262,041	9.66		
Listed hatchery	804,693	724,224	801,981	47.7	39.2	25.3	0.379	0.9	584,645	221,580	8.17		

Upper Columbia River ESU

Upper Columbia Rearing type	Number of listed fish passing dam			Of dam total, % listed fish			FGE McNary	Project Survival	Listed fish to McNary ^b	Of Fish Collected	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild****	849,301	795,721	948,424	50.4	43.0	29.9	0.379	0.9	631,402	262,041	9.66
Listed hatchery	804,693	724,224	801,981	47.7	39.2	25.3	0.379	0.9	584,645	221,580	8.17

Subyearling fall chinook salmon

Rearing type	Total Collection*		Of Granite Total & Listed Fish	Listed Fish to Granite*	FGE ¹		McNary	Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary			Granite	Goose					Low Mon
Wild****	641,469	14,307,534	51.4	628,476	0.525	0.470	0.446	0.75	27,734	14,117	0.10

Sockeye salmon

Rearing type	Total Collection*		Of Granite Total & Listed Fish	Listed Fish to Granite*	FGE ¹		McNary	Project Survival	Listed fish to McNary ^b	OI Fish Collected at McNary
	Granite	McNary			Granite	Goose				
Wild and listed hatchery*****	10,767	580,208	77.2	29,784	0.279	0.330	0.315	0.255	6,466	1,649
								0.9		0.28

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Listed wild and hatchery spring chinook salmon enter the Snake River above Lower Monumental Dam. WDFW predicts that 30,000 wild and 169,000 listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2004 (Michael Gallinat, WDFW, Pers. commun., February 2004)

***Note: Based on 2004 hatchery releases, it was estimated that 16.05611% of the hatchery fish arriving at Lower Granite Dam are products of a listed hatchery (Table 1). Because Table 2 is based on the total collection at Lower Granite Dam, which includes both wild and hatchery (listed and unlisted) fish, this estimate of 16.05611% of all hatchery fish was adjusted to 11.7% of the total collection at Lower Granite Dam.

****Note: Estimated values based on the average collection numbers from 1995-2003 (excluding 2001) (Fish Passage Center Weekly Reports), and on the average number of adult returns from 1994-2003 (excluding 2001) and the 2003 adult returns (FPC Weekly Reports 1994-2003).

*****Note: The Lower Granite Dam estimate is based on IDFG's estimate of 5,999 wild sockeye salmon smolts and 23,785 hatchery fish that overwintered in the lakes arriving at Lower Granite Dam in 2004 (Catherine Willard, IDFG, Pers. commun., February 2004). The McNary Dam estimate is the average collection count at McNary Dam from 1985-2003 (Annual Fish Passage Reports 1985-2003, and WDFW's 2003 fish counts).

1 The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted in 1995-2003 (excluding 2001) (Steven G. Smith, NMFS, Pers. commun., February 2004).

Formulas:

- a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}}) / (\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \& Listed Fish})$
- b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival})^2 + (\text{Listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low McN}}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 30,000 wild and 169,000 hatchery

PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table A1.

Table 3. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2004 under full transportation conditions (no spill).

Yearling spring/summer chinook salmon

Snake River ESU Rearing type	Total Collection*		Of Granite Total & Listed Fish	Listed Fish to Granite*	EGE		Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary			Granite	Goose			Listed Fish	& Listed Fish
Wild	5,910,194	4,907,634	27.1	2,666,935	0.60	0.65	0.9	171,373	137,098	2.79
Listed hatchery***	5,910,194	4,907,634	11.7	1,153,373	0.60	0.65	0.9	135,801	108,641	2.21

Upper Columbia River ESU

Rearing type	Number of listed fish passing dam			Of dam total, & listed fish			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Wells	Rocky Reach	Rocky Island	Wells	Rocky Reach	Rocky Island			Listed Fish	& Listed Fish
Wild****	849,301	795,721	948,424	50.4	43.0	29.9	0.9	691,402	553,122	11.27
Listed hatchery	804,693	724,224	801,981	47.7	39.2	25.3	0.9	584,645	467,716	9.53

Subyearling fall chinook salmon

Rearing type	Total Collection*		Of Granite Total & Listed Fish	Listed Fish to Granite*	EGE		Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary			Granite	Goose			Listed Fish	& Listed Fish
Wild****	672,015	18,270,839	51.4	628,476	0.55	0.60	0.75	21,476	13,959	0.08

Sockeye salmon

Rearing type	Total Collection*		Of Granite Total & Listed Fish	Listed Fish to Granite*	EGE		Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary			Granite	Goose			Listed Fish	& Listed Fish
Wild and listed hatchery*****	23,155	580,208	77.2	29,784	0.60	0.65	0.9	1,368	1,094	0.19

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Listed wild and hatchery spring chinook salmon enter the Snake River above Lower Monumental Dam. WDFW predicts that 30,000 wild and 169,000 listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2004 (Michael Gallinat, WDFW, Pers. commun., February 2004)

***Note: Based on 2004 hatchery releases, it was estimated that 16.05611% of the hatchery fish arriving at Lower Granite Dam are products of a listed hatchery (Table 1). Because Table 2 is based on the total collection at Lower Granite Dam, which includes both wild and hatchery (listed and unlisted) fish, this estimate of 16.05611% of all hatchery fish was adjusted to 11.7% of the total collection at Lower Granite Dam.

****Note: Estimated values based on the average collection numbers from 1995-2003 (excluding 2001) (Fish Passage Center Weekly Reports), and on the average number of adult returns from 1994-2003 (excluding 2001) and the 2003 adult returns (FPC Weekly Reports 1994-2003).

*****Note: The Lower Granite Dam estimate is based on IDFG's estimate of 5,999 wild sockeye salmon smolts and 23,785 hatchery fish that overwintered in the lakes arriving at Lower Granite Dam in 2004 (Catherine Willard, IDFG, Pers. commun., February 2004). The McNary Dam estimate is the average collection count at McNary Dam from 1985-2003 (Annual Fish Passage Reports 1985-2003, and WDFW's 2003 fish counts).

Formulas:

- a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}}) / (\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \% Listed Fish})$
- b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Men}}) \times (\text{Project Survival})^2 + (\text{Listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Men}}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 30,000 wild and 169,000 hatchery
 PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table A1.

Table 4. Estimated percentage composition of Snake River steelhead arriving at Lower Granite Dam from total hatchery releases projected for spring 2004. No hatchery in the Snake River ESU above Lower Granite Dam is listed.

Hatchery	Total hatchery releases ^a 2004	Survival to <u>Lower Granite Dam</u> Mean	Fish to Lower Granite Dam
Dworshak	1,800,000	0.784 ^b	1,411,200
Clearwater	1,029,000	0.638 ^b	656,502
Hagerman	1,343,000	0.784 ^c	1,052,912
Magic Valley	1,812,500	0.784 ^c	1,421,000
Niagara Springs	1,800,000	0.784 ^c	1,411,200
Irrigon (released above Lower Granite Dam)	1,128,000	0.784 ^c	884,352
Lyons Ferry (released into Grande Ronde)	160,000	0.784 ^c	125,440
Totals			
All stocks	9,072,500		6,962,606

^a Data from IDFG, ODFW, USFWS, and WDFW.

^b Survival estimate made from PIT-tag detections of marked hatchery fish releases as part of the NMFS survival studies (Research Action #1212) for 1999-2003 (excluding 2001).

^c These hatcheries have no survival estimates from the NMFS survival studies, so they were set to the survival estimate of Dworshak National Fish Hatchery.

Table 5. Estimates of listed threatened and endangered steelhead arriving at various locations during outmigration year 2004 under past transportation and spill conditions.

Snake River ESU											
Rearing type	Total Collection* Granite	Of Granite Total & Listed Fish	Listed Fish to Granite ^a	EGE ¹ Granite	Goose	Low Mon**	McNary	Project Survival	Listed fish to McNary ^b	Listed Fish	Of Fish Collected at McNary
Wild	3,448,678	507,873	17.6	1,490,036	0.408	0.451	0.444	0.192	0.9	190,713	36,617 7.21
Listed hatchery	(For some, first dam reached is Lower Monumental Dam; for others, McNary Dam)										
								0.192	0.9	0	0.00
Upper Columbia River ESU											
Rearing type	Number of listed fish passing dam			Of dam total, & listed fish			EGE ¹ McNary	Project Survival	Listed fish to McNary ^b	Listed Fish	Of Fish Collected at McNary
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island					
Wild***	261,434	347,090	370,600	33.3	32.9	29.4	0.192	0.9	270,167	51,872	10.21
Listed hatchery	523,814	654,540	842,077	66.7	62.1	66.8	0.192	0.9	742,562	142,572	28.07
Mid-Columbia River ESU											
Rearing type	Total Collection* Granite	Of Granite Total & Listed Fish	Listed Fish to Granite ^a	EGE ¹ Granite	Goose	Low Mon**	McNary	Project Survival	Listed fish to McNary ^b	Listed Fish	Of Fish Collected at McNary
Summer-run	(First dam reached is McNary Dam)										
								0.192	0.9	90,370	17,351 3.42
Winter-run	(First dam reached is Bonneville Dam)										

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Hatchery steelhead and listed wild steelhead enter the Snake River above Lower Monumental Dam. WDFW predicts that 25,000 wild fish and 204,000 non-listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2004. An additional 245,000 non-listed Snake River hatchery steelhead will outmigrate from the Touchet and Walla Walla Rivers above McNary Dam (Michael Gillanet, WDFW, Pers. commun., February 2004).

***Note: Estimated values based on 2003 collection numbers (Fish Passage Center Weekly Reports), and on the number of adult returns from 1995-2003 (FPC Weekly Reports 1995-2003).

1 The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted in 1995-2003 (excluding 2001) (Steven G. Smith, NMFS, Pers. commun., February 2004).

Formulas:

a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}}) / (\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total} \ \& \ \text{Listed Fish})$

b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{Listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{Rock Island listed fish}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 25,000 wild
PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table B1.

Table 6. Estimates of listed threatened and endangered steelhead arriving at various locations during outmigration year 2004 under full transportation conditions (no spill).

Snake River ESU											
Rearing type	Total Collection* Granite	Of Granite Total & Listed Fish	Listed Fish to Granite*	Granite Goose	FGE Low Mon**	McNary	Project Survival	Listed fish to McNary ^b	Listed Fish	at McNary	Of Fish Collected
Wild	6,762,114	1,486,450	17.6	1,490,036	0.80	0.90	0.65	0.90	17,362	15,626	1.05
Listed hatchery	(For some, first dam reached is Lower Monumental Dam; for others, McNary Dam)										
							0.90	0	0	0	0.00
Upper Columbia River ESU											
Number of listed fish passing dam											
Rearing type	Wells	Rocky Reach	Rocky Island	Wells	Of dam total, & listed fish	Rocky Reach	Rocky Island	FGE McNary	Project Survival	Listed fish to McNary ^b	Of Fish Collected
Wild***	261,434	347,090	370,600	33.3	32.9	29.4		0.90	0.9	270,167	243,150
Listed hatchery	523,814	654,540	842,077	66.7	62.1	66.8		0.90	0.9	742,562	668,306
Mid-Columbia River ESU											
Rearing type	Total Collection* Granite	Of Granite Total & Listed Fish	Listed Fish to Granite*	Granite Goose	FGE Low Mon**	McNary	Project Survival	Listed fish to McNary ^b	Listed Fish	at McNary	Of Fish Collected
Summer-run	(First dam reached is McNary Dam)										
Winter-run	(First dam reached is Bonneville Dam)										
							0.90	0.9	90,370	81,333	5.47

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Hatchery steelhead and listed wild steelhead enter the Snake River above Lower Monumental Dam. WDFW predicts that 25,000 wild fish and 204,000 non-listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2004. An additional 245,000 non-listed Snake River hatchery steelhead will outmigrate from the Touchet and Walla Walla Rivers above McNary Dam (Michael Gillanet, WDFW, Pers. commun., February 2004).

***Note: Estimated values based on 2003 collection numbers (Fish Passage Center Weekly Reports), and on the number of adult returns from 1995-2003 (FPC Weekly Reports 1995-2003).

Formulas:

a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}}) / (\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total} \ \& \ \text{Listed Fish})$

b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{Listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{Rock Island listed fish}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 25,000 wild
PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table B1.

Table 7. Juvenile collection at each of eight mainstem collection facilities in 2004 under full transportation and transportation with spill scenarios.

	Full Transportation Scenario				Transportation with Spill Scenario			
	Chinook salmon		Sockeye salmon		Chinook salmon		Sockeye salmon	
	Spring/Summer Wild	Hatchery			Spring/Summer Wild	Hatchery		
Total fish collected at:*								
Lower Granite	5,910,194	5,910,194	672,015	23,155	3,871,177	3,871,177	641,469	10,767
Little Goose	2,350,828	2,350,828	247,424	9,030	2,268,668	2,268,668	206,324	8,264
Lower Monumental	698,694	698,694	129,485	2,188	1,115,709	1,115,709	165,787	4,757
Ice Harbor**	400,533	400,533	65,552	1,182	1,080,018	1,080,018	69,502	5,586
<u>Columbia River</u>								
Wells***	1,685,687	1,685,687	NA	NA	1,685,687	1,685,687	NA	NA
Rocky Reach***	1,849,938	1,849,938	NA	NA	1,849,938	1,849,938	NA	NA
Rock Island***	3,168,248	3,168,248	NA	NA	3,168,248	3,168,248	NA	NA
Wanapum***	2,851,423	2,851,423	NA	NA	2,851,423	2,851,423	NA	NA
Priest Rapids***	2,566,281	2,566,281	NA	NA	2,566,281	2,566,281	NA	NA
McNary****	4,907,634	4,907,634	18,270,839	580,208	2,711,279	2,711,279	14,307,534	580,208
John Day** *****	1,780,376	1,780,376	4,899,489	915,363	820,584	820,584	3,350,484	186,124
The Dalles** *****	1,773,191	1,773,191	2,624,726	549,218	2,815,038	2,815,038	2,087,096	549,218
Bonneville (I & II combined)** *****	2,255,472	2,255,472	8,690,612	494,296	1,556,653	1,556,653	6,647,463	219,962
---To the tailrace of Bonneville	5,638,680	5,638,680	28,968,707	1,235,740	7,982,836	7,982,836	27,355,815	1,235,742
---To Tongue Point*****	33,826,302	33,826,302	60,475,322	1,850,321	32,345,155	32,345,155	54,863,781	1,839,738
Total listed fish at:								
Lower Granite	1,600,161	692,023	345,662	17,870	1,048,106	453,275	329,950	8,310
Little Goose	645,104	278,702	127,266	6,969	617,866	267,088	106,126	6,378
Lower Monumental	187,095	157,741	25,453	1,689	298,488	185,140	39,394	3,671
Ice Harbor**	114,249	90,534	12,886	912	293,645	180,330	16,515	4,311
<u>Columbia River</u>								
Wells***	849,301	804,693	NA	NA	849,301	804,693	NA	NA
Rocky Reach***	795,721	724,224	NA	NA	795,721	724,224	NA	NA
Rock Island***	948,424	801,981	NA	NA	948,424	801,981	NA	NA
Wanapum***	853,582	721,783	NA	NA	853,582	721,783	NA	NA
Priest Rapids***	768,224	649,605	NA	NA	768,224	649,605	NA	NA
McNary****	690,220	576,357	13,959	1,094	428,978	324,098	14,117	1,649
John Day** *****	93,180	77,808	1,973	148	88,564	66,911	3,074	529
The Dalles** *****	55,908	46,685	1,057	89	227,736	172,057	1,915	1,561
Bonneville (I & II combined)** *****	50,317	42,017	119,310	80	99,919	75,490	97,266	625
---To the tailrace of Bonneville	125,793	105,043	397,700	200	512,405	387,128	400,272	3,511
---To Tongue Point*****	8,793,862	1,781,700	13,096,892	27,822	8,490,823	1,603,753	9,067,600	23,519
Percent listed fish at:								
Lower Granite	27.07%	11.71%	51.44%	77.18%	27.07%	11.71%	51.44%	77.18%
Little Goose	27.44%	11.86%	51.44%	77.18%	27.23%	11.77%	51.44%	77.18%
Lower Monumental	26.78%	22.58%	19.66%	77.19%	26.75%	16.59%	23.76%	77.17%
Ice Harbor**	28.52%	22.60%	19.66%	77.16%	27.19%	16.70%	23.76%	77.18%
<u>Columbia River</u>								
Wells***	50.38%	47.74%	NA	NA	50.38%	47.74%	NA	NA
Rocky Reach***	43.01%	39.15%	NA	NA	43.01%	39.15%	NA	NA
Rock Island***	29.94%	25.31%	NA	NA	29.94%	25.31%	NA	NA
Wanapum***	29.94%	25.31%	NA	NA	29.94%	25.31%	NA	NA
Priest Rapids***	29.94%	25.31%	NA	NA	29.94%	25.31%	NA	NA
McNary****	14.06%	11.74%	0.08%	0.19%	15.82%	11.95%	0.10%	0.28%
John Day** *****	5.23%	4.37%	0.04%	0.02%	10.79%	8.15%	0.09%	0.28%
The Dalles** *****	3.15%	2.63%	0.04%	0.02%	8.09%	6.11%	0.09%	0.28%
Bonneville (I & II combined)** *****	2.23%	1.86%	1.37%	0.02%	6.42%	4.85%	1.46%	0.28%
---To the tailrace of Bonneville	2.23%	1.86%	1.37%	0.02%	6.42%	4.85%	1.46%	0.28%
---To Tongue Point*****	26.00%	5.27%	21.66%	1.50%	26.25%	4.96%	16.53%	1.28%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

**** Note: The percentage of listed wild and hatchery spring/summer and fall chinook salmon at McNary, John Day, and The Dalles Dams are:
For example, If you handle 1,000 yearling chinook salmon at Tongue Point, under the Full Transportation with spill scenario (above),
26.25% of them will be listed wild fish, or 263 fish. To these 263 fish, apply the percentages
listed below under the Tongue Point section to determine how many are from each ESU
(SR, $263 \times 0.3114 = 82$; UCR, $263 \times 0.0771 = 20$; etc).

Spring/Summer chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	19.86	18.80	38.91	31.60
UCR	80.14	81.20	61.09	68.40
LCR - Spring	---	---	---	---
UWR	---	---	---	---

Fall				
chinook salmon				
SR	100.00	---	100.00	---
LCR - Tule fall	---	---	---	---
LCR - Late run fall	---	---	---	---

***** Note: Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.
The percentage of listed wild and hatchery spring/summer and fall chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Spring/Summer chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	19.86	18.80	38.91	31.60
UCR	80.14	81.20	61.09	68.40
LCR - Spring	0.00	---	0.00	---
UWR	---	---	---	---

Fall				
chinook salmon				
SR	0.80	---	1.44	---
LCR - Tule fall	99.20	---	98.56	---
LCR - Late run fall	---	---	---	---

Tongue Point Spring/Summer chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	31.14	69.50	29.29	69.90
UCR	7.71	30.50	7.21	30.10
LCR - Spring	14.09	---	14.63	---
UWR	47.05	---	48.87	---

Fall				
chinook salmon				
SR	3.94	---	3.79	---
LCR - Tule fall	65.45	---	65.55	---
LCR - Late run fall	30.61	---	30.66	---

SR = Snake River ESU
UCR = Upper Columbia River ESU
LCR - Spring = Lower Columbia River ESU - Spring chinook
UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall chinook salmon
LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall chinook salmon

Use this table only if the reartype of all handled fish is known

Table 8. Juvenile spring/summer chinook salmon collection at each of the mainstem collection facilities in 2004 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

	Full Transportation Scenario Spring/Summer chinook salmon		Transportation with Spill Scenario Spring/Summer chinook salmon	
	Wild	Listed hatchery	Wild	Listed hatchery
Total fish collected at:				
Lower Granite	1,600,161	4,310,033	1,048,106	2,823,071
Little Goose	645,104	1,705,724	617,866	1,650,802
Lower Monumental	187,095	511,599	298,488	817,221
Ice Harbor**	114,249	286,284	293,645	786,373
<u>Columbia River</u>				
Wells***	849,301	836,386	849,301	836,386
Rocky Reach***	795,721	1,054,217	795,721	1,054,217
Rock Island***	948,424	2,219,824	948,424	2,219,824
Wanapum***	853,582	1,997,842	853,582	1,997,842
Priest Rapids***	768,224	1,798,058	768,224	1,798,058
McNary****	2,838,550	2,069,084	1,446,750	1,264,529
John Day** *****	1,015,049	765,326	446,118	374,467
The Dalles** *****	862,395	910,796	1,400,526	1,414,515
Bonneville (I & II combined)** *****	776,156	1,479,316	614,481	942,173
---To the tailrace of Bonneville	1,940,390	3,698,290	3,151,185	4,831,656
---To Tongue Point*****	12,142,606	21,683,696	11,533,192	20,811,963
Total listed fish at:				
Lower Granite	1,600,161	692,023	1,048,106	453,275
Little Goose	645,104	278,702	617,866	267,088
Lower Monumental	187,095	157,741	298,488	185,140
Ice Harbor**	114,249	90,534	293,645	180,330
<u>Columbia River</u>				
Wells***	849,301	804,693	849,301	804,693
Rocky Reach***	795,721	724,224	795,721	724,224
Rock Island***	948,424	801,981	948,424	801,981
Wanapum***	853,582	721,783	853,582	721,783
Priest Rapids***	768,224	649,605	768,224	649,605
McNary****	690,220	576,357	428,978	324,098
John Day** *****	93,180	77,808	88,564	66,911
The Dalles** *****	55,908	46,685	227,736	172,057
Bonneville (I & II combined)** *****	50,317	42,017	99,919	75,490
---To the tailrace of Bonneville	125,793	105,043	512,405	387,128
---To Tongue Point*****	8,793,862	1,781,700	8,490,823	1,603,753
Percent listed fish at:				
Lower Granite	100.00%	16.06%	100.00%	16.06%
Little Goose	100.00%	16.34%	100.00%	16.18%
Lower Monumental	100.00%	30.83%	100.00%	22.66%
Ice Harbor**	100.00%	31.62%	100.00%	22.93%
<u>Columbia River</u>				
Wells***	100.00%	96.21%	100.00%	96.21%
Rocky Reach***	100.00%	68.70%	100.00%	68.70%
Rock Island***	100.00%	36.13%	100.00%	36.13%
Wanapum***	100.00%	36.13%	100.00%	36.13%
Priest Rapids***	100.00%	36.13%	100.00%	36.13%
McNary****	24.32%	27.86%	29.65%	25.63%
John Day** *****	9.18%	10.17%	19.85%	17.87%
The Dalles** *****	6.48%	5.13%	16.26%	12.16%
Bonneville (I & II combined)** *****	6.48%	2.84%	16.26%	8.01%
---To the tailrace of Bonneville	6.48%	2.84%	16.26%	8.01%
---To Tongue Point*****	72.42%	8.22%	73.62%	7.71%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

**** Note: The percentage of listed wild and hatchery spring/summer and fall chinook salmon at McNary, John Day, and The Dalles Dams are:
For example, If you handle 1,000 yearling chinook salmon at Tongue Point, under the Full Transportation with spill scenario (above),
73.62% of them will be listed wild fish, or 736 fish. To these 736 fish, apply the percentages
listed below under the Tongue Point section to determine how many are from each ESU
(SR, $736 \times 0.3114 = 229$; UCR, $736 \times 0.0771 = 57$; etc).

Spring/Summer chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	19.86	18.80	38.91	31.60
UCR	80.14	81.20	61.09	68.40
LCR - Spring	---	---	---	---
UWR	---	---	---	---
Fall				
chinook salmon				
SR	100.00	---	100.00	---
LCR - Tule fall	---	---	---	---
LCR - Late run fall	---	---	---	---

***** Note: Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.
The percentage of listed wild and hatchery spring/summer and fall chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Spring/Summer chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	19.86	18.80	38.91	31.60
UCR	80.14	81.20	61.09	68.40
LCR - Spring	0.00	---	0.00	---
UWR	---	---	---	---
Fall				
chinook salmon				
SR	0.80	---	1.44	---
LCR - Tule fall	99.20	---	98.56	---
LCR - Late run fall	---	---	---	---

Tongue Point Spring/Summer chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	31.14	69.50	29.29	69.90
UCR	7.71	30.50	7.21	30.10
LCR - Spring	14.09	---	14.63	---
UWR	47.05	---	48.87	---
Fall				
chinook salmon				
SR	3.94	---	3.79	---
LCR - Tule fall	65.45	---	65.55	---
LCR - Late run fall	30.61	---	30.66	---

SR = Snake River ESU
UCR = Upper Columbia River ESU
LCR - Spring = Lower Columbia River ESU - Spring chinook
UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall chinook salmon
LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall chinook salmon

Table 9. Juvenile steelhead collection at each of the mainstem collection facilities in 2004 under full transportation and transportation with spill scenarios.

	Full Transportation Scenario		Transportation with Spill Scenario	
	Wild steelhead	Listed hatchery steelhead	Wild steelhead	Listed hatchery steelhead
Total fish collected at:				
<u>Snake River</u>				
Lower Granite	6,762,114	6,762,114	3,448,678	3,448,678
Little Goose	1,389,074	1,389,074	2,036,155	2,036,155
Lower Monumental	263,056	263,056	1,100,310	1,100,310
Ice Harbor**	114,229	114,229	942,777	942,777
<u>Columbia River</u>				
Wells***	785,764	785,764	785,764	785,764
Rocky Reach***	1,054,500	1,054,500	1,054,500	1,054,500
Rock Island***	1,260,260	1,260,260	1,260,260	1,260,260
Wanapum***	1,134,234	1,134,234	1,134,234	1,134,234
Priest Rapids***	1,020,811	1,020,811	1,020,811	1,020,811
McNary****	1,486,451	1,486,451	507,873	507,873
John Day** ****	368,731	368,731	605,343	605,343
The Dalles** ****	350,621	350,621	1,149,338	1,149,338
Bonneville (I & II combined)** *****	448,112	448,112	522,566	522,566
---To the tailrace of Bonneville	814,749	814,749	2,252,440	2,252,440
---To Tongue Point****	13,639,272	13,639,272	12,323,675	12,323,675
Total listed fish at:				
<u>Snake River</u>				
Lower Granite	1,192,029	0	607,935	0
Little Goose	244,536	0	358,850	0
Lower Monumental	34,448	0	186,443	0
Ice Harbor**	14,468	0	158,925	0
<u>Columbia River</u>				
Wells***	261,434	523,814	261,434	523,814
Rocky Reach***	347,090	654,540	347,090	654,540
Rock Island***	370,600	842,077	370,600	842,077
Wanapum***	333,540	757,869	333,540	757,869
Priest Rapids***	300,186	682,082	300,186	682,082
McNary****	340,109	668,306	105,840	142,572
John Day** ****	183,487	46,781	165,423	142,018
The Dalles** ****	150,536	30,074	315,623	242,997
Bonneville (I & II combined)** *****	184,028	29,773	146,567	101,476
---To the tailrace of Bonneville	334,596	54,133	631,754	437,397
---To Tongue Point****	2,570,467	722,439	2,321,797	579,969
Percent listed fish at:				
<u>Snake River</u>				
Lower Granite	17.63%	0.00%	17.63%	0.00%
Little Goose	17.60%	0.00%	17.62%	0.00%
Lower Monumental	13.10%	0.00%	16.95%	0.00%
Ice Harbor**	12.67%	0.00%	16.86%	0.00%
<u>Columbia River</u>				
Wells***	33.27%	66.66%	33.27%	66.66%
Rocky Reach***	32.92%	62.07%	32.92%	62.07%
Rock Island***	29.41%	66.82%	29.41%	66.82%
Wanapum***	29.41%	66.82%	29.41%	66.82%
Priest Rapids***	29.41%	66.82%	29.41%	66.82%
McNary****	22.88%	44.96%	20.84%	28.07%
John Day** ****	49.76%	12.69%	27.33%	23.46%
The Dalles** ****	42.93%	8.58%	27.46%	21.14%
Bonneville (I & II combined)** *****	41.07%	6.64%	28.05%	19.42%
---To the tailrace of Bonneville	41.07%	6.64%	28.05%	19.42%
---To Tongue Point****	18.85%	5.30%	18.84%	4.71%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established at this time. Also, there is no transportation from these dams.

**** Note: (See next page)

**** Note: The percentage of listed wild fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point. All listed hatchery fish are from the Upper Columbia River ESU.
For example, If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above), 18.84% of them will be listed wild fish, or 188 fish. To these 188 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU
(SR, $188 \times 0.5821 = 109$; UCR, $188 \times 0.1024 = 19$; etc).

McNary Dam	Full Transportation	Full Transportation with spill
SR	4.59	34.60
UCR	71.49	49.01
MCR - Summer	23.91	16.39
MCR - Winter	---	---
LCR	---	---
UWR	---	---
John Day Dam		
SR	0.65	22.88
UCR	10.16	32.41
MCR - Summer	89.19	44.71
MCR - Winter	---	---
LCR	---	---
UWR	---	---
The Dalles Dam		
SR	0.51	20.66
UCR	7.99	29.27
MCR - Summer	91.50	50.08
MCR - Winter	---	---
LCR	---	---
UWR	---	---
Bonneville Dam		
SR	0.41	18.49
UCR	6.35	26.20
MCR - Summer	72.73	44.83
MCR - Winter	5.34	2.73
LCR	15.17	7.75
UWR	---	---
Tongue Point		
SR	58.21	56.58
UCR	10.24	9.17
MCR - Summer	12.03	12.60
MCR - Winter	0.65	0.72
LCR	10.36	11.48
UWR	8.51	9.43

SR = Snake River ESU
UCR = Upper Columbia River ESU
MCR - Summer = Mid Columbia River ESU summer steelhead
MCR - Winter = Mid Columbia River ESU winter steelhead
LCR = Lower Columbia River ESU
UWR = Upper Willamette River ESU

Use this table only if the reartype of all handled fish is known

Table 10. Juvenile steelhead collection at each of the mainstem collection facilities in 2004 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

	Full Transportation Scenario		Transportation with Spill Scenario	
	Wild steelhead	Listed hatchery steelhead	Wild steelhead	Listed hatchery steelhead
Total fish collected at:				
<u>Snake River</u>				
Lower Granite	1,192,029	5,570,085	607,935	2,840,743
Little Goose	244,536	1,144,538	358,850	1,677,305
Lower Monumental	34,448	228,608	186,443	913,867
Ice Harbor**	14,468	99,761	158,925	783,852
<u>Columbia River</u>				
Wells***	261,434	523,814	261,434	523,814
Rocky Reach***	347,090	707,410	347,090	707,410
Rock Island***	370,600	889,660	370,600	889,660
Wanapum***	333,540	800,694	333,540	800,694
Priest Rapids***	300,186	720,625	300,186	720,625
McNary****	340,109	1,146,342	105,840	402,033
John Day** ****	183,487	185,244	165,423	439,920
The Dalles** ****	150,536	200,085	315,623	833,715
Bonneville (I & II combined)** *****	184,028	264,084	146,567	375,999
---To the tailrace of Bonneville	334,596	480,153	631,754	1,620,685
---To Tongue Point*****	2,602,246	11,060,851	2,353,576	9,973,895
Total listed fish at:				
<u>Snake River</u>				
Lower Granite	1,192,029	0	607,935	0
Little Goose	244,536	0	358,850	0
Lower Monumental	34,448	0	186,443	0
Ice Harbor**	14,468	0	158,925	0
<u>Columbia River</u>				
Wells***	261,434	523,814	261,434	523,814
Rocky Reach***	347,090	654,540	347,090	654,540
Rock Island***	370,600	842,077	370,600	842,077
Wanapum***	333,540	757,869	333,540	757,869
Priest Rapids***	300,186	682,082	300,186	682,082
McNary****	340,109	668,306	105,840	142,572
John Day** ****	183,487	46,781	165,423	142,018
The Dalles** ****	150,536	30,074	315,623	242,997
Bonneville (I & II combined)** *****	184,028	29,773	146,567	101,476
---To the tailrace of Bonneville	334,596	54,133	631,754	437,397
---To Tongue Point*****	2,570,467	722,439	2,321,797	579,969
Percent listed fish at:				
<u>Snake River</u>				
Lower Granite	100.00%	0.00%	100.00%	0.00%
Little Goose	100.00%	0.00%	100.00%	0.00%
Lower Monumental	100.00%	0.00%	100.00%	0.00%
Ice Harbor**	100.00%	0.00%	100.00%	0.00%
<u>Columbia River</u>				
Wells***	100.00%	100.00%	100.00%	100.00%
Rocky Reach***	100.00%	92.53%	100.00%	92.53%
Rock Island***	100.00%	94.65%	100.00%	94.65%
Wanapum***	100.00%	94.65%	100.00%	94.65%
Priest Rapids***	100.00%	94.65%	100.00%	94.65%
McNary****	100.00%	58.30%	100.00%	35.46%
John Day** ****	100.00%	25.25%	100.00%	32.28%
The Dalles** ****	100.00%	15.03%	100.00%	29.15%
Bonneville (I & II combined)** *****	100.00%	11.27%	100.00%	26.99%
---To the tailrace of Bonneville	100.00%	11.27%	100.00%	26.99%
---To Tongue Point****	98.78%	6.53%	98.65%	5.82%

* Note: "Total fish collected at:" is the total number of fish collected of that species, run and rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

**** Note: The percentage of listed wild fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point. All listed hatchery fish are from the Upper Columbia River ESU.
For example, If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above), 98.65% of them will be listed wild fish, or 987 fish. To these 987 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU
(SR, $987 \times 0.5821 = 575$; UCR, $987 \times 0.1024 = 101$; etc).

McNary Dam	Full Transportation	Full Transportation with spill
SR	4.59	34.60
UCR	71.49	49.01
MCR - Summer	23.91	16.39
MCR - Winter	---	---
LCR	---	---
UWR	---	---
John Day Dam		
SR	0.65	22.88
UCR	10.16	32.41
MCR - Summer	89.19	44.71
MCR - Winter	---	---
LCR	---	---
UWR	---	---
The Dalles Dam		
SR	0.51	20.66
UCR	7.99	29.27
MCR - Summer	91.50	50.08
MCR - Winter	---	---
LCR	---	---
UWR	---	---
Bonneville Dam		
SR	0.41	18.49
UCR	6.35	26.20
MCR - Summer	72.73	44.83
MCR - Winter	5.34	2.73
LCR	15.17	7.75
UWR	---	---
Tongue Point		
SR	58.21	56.58
UCR	10.24	9.17
MCR - Summer	12.03	12.60
MCR - Winter	0.65	0.72
LCR	10.36	11.48
UWR	8.51	9.43

SR = Snake River ESU
UCR = Upper Columbia River ESU
MCR - Summer = Mid Columbia River ESU summer steelhead
MCR - Winter = Mid Columbia River ESU winter steelhead
LCR = Lower Columbia River ESU
UWR = Upper Willamette River ESU

Table 11. Estimated number of listed fish outmigrating from each ESU, 2004.

ESU	Species	Run	Number of listed fish	
			Wild	Hatchery ^a
Snake River	Chinook	Spring/summer	2,666,935	2,329,122
		Fall	628,476	
	Steelhead	Summer	1,515,036	0
	Sockeye		5,999	23,785
Upper Columbia	Chinook	Spring	1,112,926	1,191,179
	Steelhead	Summer	431,453	1,006,000
Mid-Columbia	Steelhead	Summer	383,644	
		Winter	16,557	
Lower Columbia	Chinook	Spring	1,152,358	
		Fall (tule)	8,572,269	
		Fall (late run)	4,009,111	
	Steelhead	Summer/Winter	263,832	
Upper Willamette	Chinook	Spring	3,847,700	
	Steelhead	Winter	216,737	
Columbia River	Chum		No estimate	

^a Listed hatchery numbers are release numbers.

Appendix A.

Determination of the effects of returning all PIT-tagged spring/summer chinook salmon to the river at each collection dam on the number of fish that arrive at each subsequent dam

We surveyed researchers regarding the number of outmigrating PIT-tagged spring/summer chinook salmon in the Snake River we could expect in 2004. We found that 227,000 hatchery fish will be PIT tagged and released above Lower Granite Dam as part of the Comparative Survival Study (CSS). We applied the hatchery survival estimates found in Table 1 to the fish released from hatcheries to determine the number of CSS hatchery fish that will arrive at Lower Granite Dam (145,272). The CSS requires that 70% of the fish collected at each of the Snake River collector dams be transported.

Another 27,109 hatchery spring/summer chinook salmon (PIT tagged at hatcheries (not part of the CSS) and traps) will arrive at Lower Granite Dam. Of the 172,381 (145,272 + 27,109) hatchery fish reaching Lower Granite Dam, 44,102 will be listed hatchery fish.

Because tagging for the 2004 outmigration year began in July 2003 and continues throughout the outmigration year, we cannot accurately estimate survival from tagging of natural and inriver fish to the head of the Lower Granite Reservoir. We assumed that all of these fish would survive to the head of the reservoir, realizing that this is an overestimation. We chose the head of the reservoir because that is where the last of the tagging occurs, and because we have survival estimates from the head of the reservoir to the tailrace of Lower Granite Dam. It is expected that 66,606 wild spring/summer chinook salmon will be PIT tagged above Lower Granite Dam. Using 90% survival from tagging location through the Lower Granite Dam pool, 59,945 ($66,606 \times 0.90$) will arrive at Lower Granite Dam.

NOAA Fisheries will be PIT-tagging fish at Lower Granite Dam during the 2004 outmigration. As part of this marking, 10,000 PIT-tagged wild fish will be released into the Lower Granite Dam tailrace. As these fish move downstream, all of those collected at Little Goose and Lower Monumental Dams will be diverted back to the river.

Approximately 4,400 fish (400 wild and 4,000 hatchery) will be released in the Tucannon River. These fish are assumed to arrive at Lower Monumental Dam with no mortality.

We performed two calculations to determine the expected number of PIT-tagged fish collected at each collector dam. The first calculation made use of the same formulas used under the "Transportation with Spill" and "Full Transportation" scenarios which assume that every fish collected is transported (except the CSS fish). This calculation provided the number of fish collected at each dam if no PIT-tagged fish were returned to the river. In other words, this calculation is based solely on the number of fish that are not collected and transported at upstream dam(s).

In the second calculation we assumed that the only fish transported at each Snake River collector dam are the CSS fish. This calculation provided the number of fish collected at each dam if the remaining PIT-tagged fish were returned to the river. This calculation includes both the fish that were returned to the river at upstream dam(s) and the fish that were not collected at upstream dam(s). Because the number derived from the second calculation includes the number from the first calculation, the difference between the numbers from these two calculations is the number of PIT-tagged fish that were collected at each dam that were not accounted for because they were returned to the river at each dam (the number for each dam was added to the appropriate "... fish collected ..." columns in Tables 7-8). This difference in the number of fish collected was then expanded to the number of fish that arrived at the dam by dividing by the FGE of that dam, and was added to the number of fish that arrived at McNary Dam because they had not been collected and transported at upstream dams under both the "Transportation with Spill" and "Full Transportation" scenarios (column "Listed fish to McNary" in Tables 2 and 3, respectively).

Calculation 1 (Transportation)

Transportation with Spill Scenario--The numbers presented below assume that 60.7% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 39.3%), and that 30% of the CSS fish are returned to the river. In addition, 10,000 wild fish will be released into the tailrace of Lower Granite Dam from marking at the dam.

Using the FGEs in Table 2, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2004 will be

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	17,451	10,071	29,293	56,815
Lower Monumental	8,061	6,016	13,288	27,365
McNary	4,362	3,255	7,189	14,806

Full Transportation Scenario--The numbers presented below assume that 40.0% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 60.0%), and that 30% of the CSS fish are returned to the river. In addition, 10,000 wild fish will be released into the tailrace of Lower Granite Dam from marking at the dam.

Using the FGEs in Table 3, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2004 will be

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	19,877	10,320	30,018	60,215
Lower Monumental	5,016	4,501	7,274	16,791
McNary	3,251	2,917	4,714	10,882

Calculation 2 (Only CSS and NMFS fish transported)

This calculation assumes that all collected PIT-tagged fish (except the CSS fish) are returned to the river at each Snake River collector dam.

For the PIT-tagged fish returned to the river at each collection dam, the only loss of fish as they migrate downstream is the mortality through each reservoir and dam. Based on the NMFS survival studies, survival through each reservoir and dam was estimated to be 90%. The estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2004 will be

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	26,313	13,783	36,032	76,128
Lower Monumental	19,429	10,504	20,737	50,670
McNary	15,953	8,031	13,769	37,753

Full Transportation Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	40,918	19,133	46,016	106,067
Lower Monumental	25,896	12,346	19,230	57,472
McNary	32,642	14,425	18,061	65,128

Subtracting collection numbers estimated by Calculation 1 from Calculation 2 provides the number of unaccounted for PIT-tagged fish that were collected at each dam (Appendix Table A1).

Appendix Table A1. Estimates of the number of unaccounted for PIT-tagged spring/summer chinook salmon that will be collected at each of the collection dams, and estimates of how many of these fish will arrive at McNary Dam, 2004.

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	8,862	3,712	6,739	19,313
Lower Monumental	11,368	4,488	7,449	23,305
McNary	11,591	4,776	6,580	22,947
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.379):				
McNary	30,583	12,602	17,361	60,546

Full Transportation Scenario (No Spill)

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	21,041	8,813	15,998	45,852
Lower Monumental	20,880	7,845	11,956	40,681
McNary	29,391	11,508	13,347	54,246
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.80):				
McNary	36,739	14,385	16,684	67,808

Appendix B.

Determination of the effects of returning all PIT-tagged steelhead to the river at each collection dam on the number of fish that arrive at each subsequent dam

We surveyed researchers regarding the number of outmigrating PIT-tagged steelhead in the Snake River we could expect in 2004. We found that 25,613 hatchery fish will be PIT tagged and released above Lower Granite Dam. Based on the survival rates of the various hatcheries releasing fish, we estimate that 13,193 will arrive at Lower Granite Dam. Another 12,420 hatchery steelhead (PIT tagged at traps) will arrive at Lower Granite Dam, bringing the total to 25,613 hatchery fish arriving at Lower Granite Dam. In addition, 4,860 wild steelhead PIT tagged at traps will arrive at Lower Granite Dam.

NOAA Fisheries will be PIT-tagging steelhead at Lower Granite Dam during the 2004 outmigration. As part of this marking, 30,000 PIT-tagged fish will be released into the Lower Granite Dam tailrace. Of these, approximately 10,000 will be wild fish and 20,000 will be hatchery fish. All of the fish collected at Little Goose and Lower Monumental Dams will be diverted back to the river.

We performed two calculations to determine the expected number of PIT-tagged fish collected at each collector dam. The first calculation made use of the same formulas used under the "Transportation with Spill" and "Full Transportation" scenarios which assume that every fish collected is transported. This calculation provided the number of fish collected at each dam if no PIT-tagged fish were returned to the river. In other words, this calculation is based solely on the number of fish that are not collected and transported at upstream dam(s).

In the second calculation we assumed that no fish are transported. This calculation provided the number of fish collected at each dam if all PIT-tagged fish were returned to the river. This calculation includes both the fish that were returned to the river at upstream dam(s) and the fish that were not collected at upstream dam(s). Because the number derived from the second calculation includes the number from the first calculation, the difference between the numbers from these two calculations is the number of PIT-tagged fish that were collected at each dam that were not accounted for because they were returned to the river at each dam (the number for each dam was added to the appropriate "... fish collected ..." columns in Tables 9-10). This difference in the number of fish collected was then expanded to the number of fish that arrived at the dam by dividing by the FGE of that dam, and was added to the number of fish that arrived at McNary Dam because they had not been collected and transported at upstream dams under both the "Transportation with Spill" and "Full Transportation" scenarios (column "Listed fish to McNary" in Tables 5 and 6, respectively).

Calculation 1 (Transportation)

Transportation with Spill Scenario--Assuming that 59.2% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 40.8%), 2,877 ($4,860 \times 0.592$) wild and 15,163

(25,613 x 0.592) unlisted hatchery fish will reach the Lower Granite Dam tailrace. In addition, 10,000 wild and 20,000 unlisted hatchery fish will be released into the tailrace from marking at the dam. Therefore, the total numbers of PIT-tagged fish in the Lower Granite Dam tailrace will be 12,877 (2,877 + 10,000) wild and 35,163 (15,163 + 20,000) unlisted hatchery fish.

Using the FGEs in Table 5, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2004 will be

Dam	Wild	Unlisted hatchery	Total
Little Goose	5,227	14,273	19,500
Lower Monumental	2,765	7,409	10,174
McNary	538	1,577	2,115

Full Transportation Scenario--Assuming that 20.0% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 80.0%), 972 (4,860 x 0.20) wild and 5,123 (25,613 x 0.20) unlisted hatchery fish will reach the Lower Granite Dam tailrace. In addition, 10,000 wild and 20,000 unlisted hatchery fish will be released into the tailrace from marking at the dam. Therefore, the total numbers of PIT-tagged fish in the Lower Granite Dam tailrace will be 10,972 (972 + 10,000) wild and 25,123 (5,123 + 20,000) unlisted hatchery fish.

Using the FGEs in Table 6, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2004 will be

Dam	Wild	Unlisted hatchery	Total
Little Goose	8,887	20,350	29,237
Lower Monumental	903	2,005	2,908
McNary	354	1,417	1,771

Calculation 2 (No Transportation)

Assuming that 100% of the collected PIT-tagged fish are returned to the river at Lower Granite Dam, 14,860 (4,860 + 10,000) wild and 45,613 (25,613 + 20,000) unlisted hatchery fish will reach the tailrace.

Because 100% of the PIT-tagged fish were assumed to be returned to the river at each collection dam, the only loss of fish as they migrate downstream is the mortality through each reservoir and dam. Based on the NMFS survival studies, survival through

each reservoir and dam was estimated to be 90%. The estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2004 will be

Transportation with Spill Scenario

Dam	Wild	Unlisted hatchery	Total
Little Goose	6,032	18,514	24,546
Lower Monumental	3,944	16,870	20,814
McNary	1,075	5,909	6,984

Full Transportation Scenario

Dam	Wild	Unlisted hatchery	Total
Little Goose	12,037	36,946	48,983
Lower Monumental	3,411	24,697	28,108
McNary	3,442	28,329	31,771

Subtracting collection numbers estimated by Calculation 1 from Calculation 2 provides the number of unaccounted for PIT-tagged fish that were collected at each dam (Appendix Table B1).

Appendix Table B1. Estimates of the number of unaccounted for PIT-tagged steelhead that will be collected at each of the collection dams, and estimates of how many of these fish will arrive at McNary Dam, 2004.

Transportation with Spill Scenario

Dam	Wild	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:			
Little Goose	805	4,241	5,046
Lower Monumental	1,179	9,461	10,640
McNary	537	4,332	4,869
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.192):			
McNary	2,795	22,563	25,358

Full Transportation Scenario (No Spill)

Dam	Wild	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:			
Little Goose	3,150	16,596	19,746
Lower Monumental	2,508	22,692	25,200
McNary	3,088	26,912	30,000
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.90):			
McNary	3,431	29,902	33,333